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SARS-CoV-2 transmission modes: Why and how contamination occurs around shared meals and drinks?

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ABSTRACT

In spite of prevention measures enacted all over the world to control the COVID-19 pandemic outbreak, including mask wearing, social distancing, hand hygiene, vaccination, and other precautions, the SARS-CoV-2 virus continues to spread globally at an unabated rate of about 1 million cases per day. The specificities of superspreading events as well as evidence of human-to-human, human-to-animal and animal-to-human transmission, indoors or outdoors, raise questions about a possibly neglected viral transmission route. In addition to inhaled aerosols, which are already recognized as key contributors to transmission, the oral route represents a strong candidate, in particular when meals and drinks are shared. In this review, we intend to discuss that significant quantities of virus dispersed by large droplets during discussions at festive gatherings could explain group contamination either directly or indirectly after deposition on surfaces, food, drinks, cutlery, and several other soiled vectors. We suggest that hand hygiene and sanitary practices around objects brought to the mouth and food also need to be taken into account in order to curb transmission.

1. Introduction

Symptomatic and asymptomatic COVID-19 patients, vaccinated or not, were found to present the same viral load (Zuin et al., 2021; Acharya et al., 2022) and emit large droplets and aerosols when they speak and especially when they cough and sneeze (Stadnytskyi et al., 2021). The question of contamination through the mouth, eyes or nose still needs to be addressed, whether it happens directly by inhalation (face to face), and/or - which is also theoretically possible - indirectly through contaminated objects (plate, cutlery) put in the mouth or even through ingestion of soiled food or beverages (Fig. 1).

The oro-digestive infection route has been explored in hACE-2 mice (Sun et al., 2020) and in non-human primates (Jiao et al., 2021) where intragastric inoculation of SARS-CoV-2 resulted in productive infection of digestive tissues and consecutive inflammation of the lungs. In February 2020, one of the first descriptions of SARS-CoV-2 transmission involved people in a restaurant where ventilation and aerosols had been incriminated. At that time, data on the infectious status of waiters and viral contamination of hands, surfaces or food (cross-contamination) were missing (Lu et al., 2020).

We hypothesized that transmission of SARS-CoV-2 through the sharing of soiled utensils, food, and drink could be another probable effective infection route based on numerous clinical, experimental, virological, and epidemiological arguments (Wendling et al., 2021). In this review, we outline evidence suggesting that the commonly accepted aerosol transmission route (*via* inhalation) is not the only way of SARS-CoV-2 infection and that oral transmission (*via* ingestion) may also be considered to maximize the efficiency of public health measures and interventions.

2. Methods

In order to provide the most accurate summary of the literature, a search query was built as a combination of three sets of terms that

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related to the following keywords: transmission mode, SARS-CoV-2, respiratory viruses, oral route, preventive medicine, risk management.

The MEDLINE bibliographic database was searched using the PubMed search tool. To ensure the highest level of sensitivity, no limitations were imposed on publication dates and languages. The results of the query were screened based successively on the title, the abstract and the full text. Every reference that described a SARS-CoV-2 transmission mode around shared meals and drinks was included, regardless of study design considerations. The references of every included document were also screened to identify relevant additional sources, a method calledsnowballing. Complementarily, reverse snowballing was performed by identifying relevant documents that cited the included studies, using the Google Scholar search engine. This literature review intends to address the five following questions in a narrative way: 1) What do we learn from indoor and outdoor transmission patterns? 2) Are superspreading events substantial in restaurants and bars? 3) What does epidemiology tell us about the risk associated with consumption of food and drinks in social settings? 4) What is a likely explanation for the high risk associated with shared meals? and 5) Can hands or food be involved as vectors?

3. Results

3.1. What do we learn from indoor and outdoor transmission patterns?

In Catalonia, during outdoor festivals, despite vaccinations, mandatory tests and FFP2 masks given at the entrance, 757 infection cases were recorded out of 18,275 participants (4.14% *versus* 1.69% of non-participating controls) on a single day of the first event, where consumption of food and drinks was authorized everywhere. At a second outdoor festival with the same mask wearing and testing requirements, 662 infection cases were observed out of 27,347 participants (2.42% *versus* 1.10% non-participating controls) over the course of the 3-day event, with consumption prohibited at concerts but allowed elsewhere. Authors estimate that the increased risk observed in this cohort of attendees was consistent with what was reported earlier for going to restaurants and bars (Suñer et al., 2022). An important factor that differentiates the first festival from the second (with infection rate twice as high for a duration three times shorter) seems to be the rules allowing or prohibiting the consumption of food and drinks. In contrast, massive "Black Lives Matter" protests in 12 international cities, with mask wearing prevalence ranging from 69% to 96%, showed no increase in the incidence of COVID-19 after the protests in 11 of the 12 cities (Quigley et al., 2022). These protest events generally do not include food or beverage stands (Quigley et al., 2022) unlike the two music festivals previously described (Suñer et al., 2022).

Likewise, during the Delta virus spread period, in Boston University, out of more than 140,000 in-person class events, only nine cases of potential in class transmission were found, but after whole-genome sequencing, significant genetic distance was identified between all potential classroom transmission pairs, providing evidence that all individuals were infected outside the classroom (Kuhfeldt et al., 2022). Another study showed that attending in person classes with an infected student was not associated with a higher risk of infection (adjusted Odds Ratio (aOR) 1.0; 95% confidence interval (CI) 0.5–2.2). Students reporting infection had attended social gatherings where food and drinks were in all likelihood shared (aOR 2.8; 95% CI 1.3–6.4). Phylogenetic analyses suggested that most cases shared a common viral source (Bart et al., 2022).

Odds Ratio (OR) of SARS-CoV-2 transmission indoors is high (OR 18.7; 95% CI 6.0–57.9) compared to outdoors even if the outdoors risk persists (10%). However significant gaps remain in understanding the respective contributions of specific transmission routes (Bulfone et al., 2021).

Furthermore, the SARS-CoV-2 contamination of wild and dangerous animals in two zoos (Grome et al., 2022; Nagy et al., 2022) in spite of drastic protocols for the protection of the caretakers (distancing, masks, gloves, hand hygiene and disinfection mats) was not explained by the authors. The airborne transmission in such a context is insufficient to actually explain the reality; an alternative transmission route by soiled food/drinks prepared by the sick caretakers should be considered to contribute. Altogether, in situations where people gather outside or inside (observational studies), food and drinks sharing could be a discriminant factor found in agreement when SARS-CoV-2 infection occurs.

3.2. Are superspreading events substantial in restaurants and bars?

Many public spaces that involve eating or drinking, such as restaurants and bars but also festive gatherings such as weddings, have been associated with spreading events. For instance, in the state of Maine (USA), an index case attending a wedding contaminated subsequently two employees and 28 attendees (attack rate 49%) (Mahale et al., 2020). 177 COVID-19 cases in the community were later linked to this single event. In Bali, 23 of 41 guests were infected at a wedding: they shared drinks and shisha. Attack rates ranged from 64% to 87% amongst guests depending on their respective levels of exposure (Ravindran et al., 2020). High attack rates at weddings very likely could be linked to the impossibility to maintain adequate physical distancing (often less than 1 m face to face), displays of affection amongst family members, the ambient noise or alcohol consumption which prompts individuals to unconsciously raise the volume of their voice and triggers more droplet emission (Ahmed et al., 2022). Festive gatherings other than family reunions also present a higher than normal potential for spread. For example, Saint Patrick's Day celebrations at a bar in Ho Chi Minh City, resulted in a superspreading event. Retro-tracking showed that the waiter was the index case on March 16, 2020: 12 customers of the bar were later infected (Chau et al., 2021). In February 2021, at an indoor

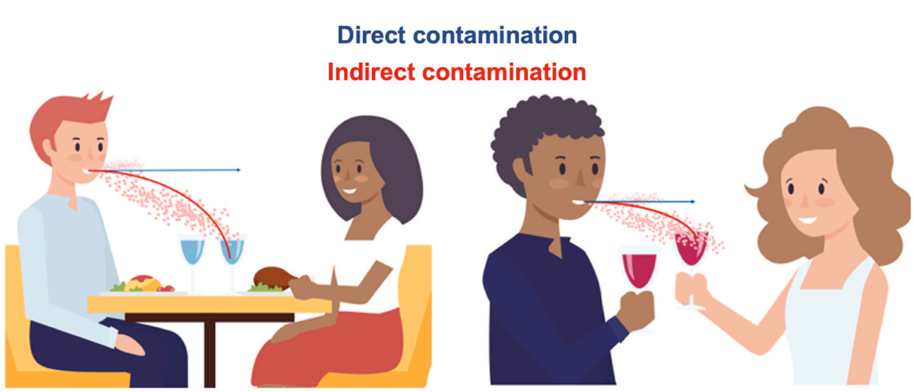

Fig. 1. Contamination by direct or indirect projection through ingestion of soiled food or drinks in bars or restaurants.

bar in a rural Illinois county, 46 COVID-19 cases were associated with the opening event, including 26 clients and 3 employees (Sami et al., 2021), the remaining 17 cases being secondary infections. Restaurants are likewise particularly prone to SARS-CoV-2 spread. Twenty cases were linked to restaurant exposure on July 25, 2020. Indoor dining was identified as a factor in SARS-CoV-2 transmission. One reliable determinant of infection was consumption of spirit beverages prepared and served indoor by the index case (Capon et al., 2021). In Thaïland, a group of 11 participants at a farewell party were infected after drinking alcoholic beverages from the same glass. Investigation showed that the other four people who attended the party and did not drink did not develop illness (Mungmungpuntipantip and Wiwanitkit, 2020).

Evidence also suggests that vaccination does not prevent super-spreading events. In France, in November 2021, 129 participants (required to have a complete primary vaccination schedule or past infection) attended an event including a dinner followed by a dance party. The overall attack rate (confirmed and probable B.1.640 infection cases) was 50.4% (65/129) (Mastrovito et al., 2022). Later, at a Christmas gathering held in a restaurant in Oslo, 81 of 111 fully vaccinated people became infected: the total attack rate for the Omicron variant was 74% (Brandal et al., 2021). In early December 2021, a super-spreading event amongst triple-vaccinated healthcare workers occurred in the Faroe Islands: 21 of 33 participants were infected at a festive gathering, which corresponds to an attack rate of 63.6% (Helmsdal et al., 2022). More recently, there has been a multistate outbreak of Omicron infections following a bar event in Chicago. Fifteen confirmed cases subsequently dispersed to Colorado, Illinois, Louisiana, Missouri, and Michigan with isolates that matched the Omicron sequence (B.1.1.529, sublineage BA.1) and were closely related from a phylogenetic standpoint. Most of the young individuals (80%, 12/15) were fully vaccinated (Spencer et al., 2022). According to the literature, there has not been, to this date, any published data on clusters in playhouses or movie theaters while numerous publications or press articles outlined examples of transmission in settings where food is served (restaurants, bars, festive gathering). In view of these results, social events seem to present a high probability of SARS-CoV-2 contamination, but more relevantly, drinking (or sharing glasses) needs to be considered as an alternative transmission route.

3.3. *What does epidemiology tell us about the risk associated with consumption of food and drinks in social settings?*

Epidemiological studies have shown that sharing meals or drinks seems to be strongly linked to SARS-CoV-2 infection: a retrospective case-control study comparing caregivers between a "sick" group and a "healthy" group showed a strong association with going to a restaurant or bar (aOR 16.2; 95% CI 8.6–30.5), much more than with continuous and prolonged contact without masks with COVID-19 patients (aOR 2.3; 95% CI 1.1–4.9) (Lentz et al., 2021). CDC reports that case-patients were more susceptible than controls to have eaten at a restaurant (aOR 2.8; 95% CI 1.9–4.3) or to have gone to a bar or coffee shop (aOR 3.9; 95% CI 1.5–10.1) in the two weeks before illness onset (Fisher et al., 2020). In addition, a Danish case-control study on 617 individuals showed that among societal activities, drinking in a bar was strongly associated with infection (OR 10; 95% CI 1.5–65) while other activities such as singing (OR 2.1; 95% CI 1.1–4.1) and attending fitness centers (OR 1.8; 95% CI 1.1–2.8) led to lower but still significant spread (Munch et al., 2022). In 102 Norwegian municipalities, out of 25,392 bartenders and waiters, COVID-19 had been reduced by 60% and by almost 50% in municipalities introducing full and partial bans on serving alcohol in pubs and restaurants respectively (Methi et al., 2022). A Norwegian Public Health team showed in June 2021 that visiting a coffee shop, restaurant or bar and eating at a table increased the risk of infection (aOR 3.2; 95% CI 1.5–6.6). Furthermore, attending a gathering of more than 10 participants did not increase the COVID-19 risk while alcohol consumption (in a group) seems associated with an increasing trend in infection risk (aOR 1.7; 95% CI 0.9–3.1) (Stålcrantz et al., 2021).

Moreover, in a meta-analysis of 32 studies with 68,260 participants, the secondary attack rate of meal or gathering settings (81,4%) was nearly three or four times higher than that of transportation (30,8%) (RR 3.91; 95% CI 1.85–8.27) or medical care (18,2%) (RR 3.13; 95% CI 1.34–7.29) where meals are not shared (Zhao et al., 2021). Even in gyms, outbreaks are associated with food consumption: in a taekwondo gym, 30 out of 108 young athletes were infected (attack rate 27.8%). In multivariate logistic regression analysis, the excess risk associated with food consumption inside the gym was 300% ($p = 0.03$) (Shin et al., 2022). The SARS-CoV-2 transmission risk is undoubtedly related to the viral load of the index case (753 secondary contacts from 282 index cases): the secondary attack rate ranged from 12% when the index case had a viral load lower than 1×10^6 copies/mL to 24% when the index case had a viral load of 1×10^{10} copies/mL or higher (Marks et al., 2021). According to an observational study, individuals who transmitted ($n = 80$) had an average viral genome load approximately 6.5-fold higher than individuals who did not ($n = 366$) (Bjorkman et al., 2021). Moreover, because humans also socialize and share environments with animals, it is worth noting that food sharing between infected owners and their pets was found to be associated in a statistically significant manner with SARS-CoV-2 infection in cats or dogs (Alberto-Orlando et al., 2022).

3.4. *What is a likely explanation for the high risk associated with shared meals?*

As clearly observed throughout these real-life studies, the contamination can be either direct by projection from the mouth to the face in case of proximity or indirect by projection of droplets in nearby glasses and plates containing food, or on the cutlery which is subsequently brought to the mouth.

Based on these observations, a rather important question needs to be addressed, specifically: what is the mechanism underlying such large and frequent contamination events around shared meals? Bioaerosols produced while speaking or coughing by contagious patients may contain large amounts of SARS-CoV-2 RNA, but their infectivity remains uncertain, unlike large droplets found to be infectious after culture (Johnson et al., 2022). We surmise that large contaminated droplets emitted while eating and speaking could be responsible for this enhanced transmission efficacy. In fact, SARS-CoV-2 was shown to replicate in the salivary glands and the oral cavity (in patients' and postmortem human biopsies) (Drozdzik and Drozdzik, 2022). Expectorated sputum samples demonstrated the highest percentage of SARS-CoV-2 positive infectious samples (71%, 2.9×10^2 to 5.2×10^5 PFU/mL), followed by saliva samples (58%, 1×10^1 to 4.6×10^4 PFU/mL), and then cough samples (19%, 5×10^1 to 1.9×10^3 PFU/mL) (Lin et al., 2022). It is interesting to underline that the dynamic of salivary secretion of SARS-CoV-2 virus (kinetics distinct from the nasopharyngeal one) coincided with the onset of COVID-19 symptoms, including loss of taste (Huang et al., 2021). Altogether, these studies show that the mouth is an important site for SARS-CoV-2 replication which involves saliva as a potential SARS-CoV-2 infection source.

A recent study seems to support this hypothesis by evaluating the aerosol and the droplet contamination features. Droplet emission and deposition from a speaking subject sitting at a table were measured on several black circular plates covering the table surface *via* fluorescent imaging technique (FIT). The subjects were asked to swallow and chew fluorescent vitamin B2 until saturation of the saliva and then to talk loudly for 3 min, in this sitting configuration. Immediately after, all the black plates were analyzed (experimental visualization setup in darkroom) to evaluate the number, the size, position and the distance of the droplets from the speaker. The study showed that large droplets were projected from the source and settled all over the analyzed surface (750 × 1250 mm). Droplet sizes were found to range from 43 to 2,155 μm and averaged 421 μm. The average count of the total number of droplets deposited was 1095 from 3-min of uninterrupted speech (Fig. 2).

The authors evaluate the risk of viral transmission by speech to be close to 100% when the index case has a high viral load (1×10^8 RNA copies/mL; genomic titer estimate of which only a fraction is infectious viruses), due to the large droplets deposited on plates (Ding et al., 2022).

Indeed, this study of emitted droplet size distribution by distance from the source first allows us to assess the risk of transmission. The following reasoning could be drawn: if the concentration of virions is known in a volume of 1 mL (viral load), the number of viral particles contained in a droplet of 421 μm (mean size) in diameter (d) can be deduced by calculating the volume (V) of an equivalent sphere and applying the same concentration.

$$V = \frac{4}{3}\pi\left(\frac{d}{2}\right)^3$$

Thus, for a high viral load of 1×10^8 virions/mL (1 mL = sphere with a diameter of ≈1.24 cm), a single droplet of 421 μm in diameter (mean size) theoretically contains approximately 3900 virions and for the largest droplet of 2,155 μm in diameter, a quantity of likely more than 520,000 virions. The average RNA/PFU (PCR targeted N gene) ratio was found around 160,000 RNA copies/PFU (Lin et al., 2022). Thus, each large droplet that contains 520,000 virions is likely to include about 3.25 PFU.

The quantity of virions, thrown in tens of droplets, put in the mouth suggests a high risk of oral infection from contaminated food, drink or cutlery, especially if this sequence of events is iterative, during a short exposure time. To date, the minimal infectious dose of SARS-CoV-2 has never been evaluated by oral ingestion but was determined by nasal route in a clinical trial under experimental infection conditions: eighteen participants (53%) among 36 volunteers aged 18–29 years were infected by intranasal inoculation of 10 $TCID_{50}$ of wild-type SARS-CoV-2 (pre-alpha strain), equivalent to 55 FFU according to the authors (Killingley et al., 2022). This inoculum is consistent with the one of 14 PFU SARS-CoV-2 (another pre-alpha strain) which lead to a productive infection in Syrian golden hamsters (Lin et al., 2022). Therefore, a few large droplets is expected to contain an infectious dose well above the threshold of 10 $TCID_{50}$. However, tests on animals or human subjects are required to unequivocally demonstrate the contribution of oro-digestive transmission, *e.g.* through the ingestion of previously contaminated food.

The second conclusion that emerges from the Ding et al. study, is that the sitting position of guests associated with talking during the meal appears to be a determining factor. In a four-person dining scenario, the risk of infection for participants sitting diagonally to the speaker was lowest. Moreover, there was no significant difference between sitting face-to-face and sitting side-by-side if the speaker turned his head while speaking (Ding et al., 2022). A study conducted in South Korea from January 2020 to September 2021 on 14,751 healthcare workers tracked 33 index cases through video recordings with 98 other healthcare workers exposed during the meal. The study showed that in a side-by-side eating configuration, while talking, the risk of an index case infecting his neighbor was 12.5% (3/24): this occurrence was zero for those who were side-by-side and not talking to each other (0/74) ($p = 0.013$) (Jung et al., 2022).

Large particles emitted while speaking during a meal must be seriously considered as potential vectors for micro-organisms transfer. PVC or plexiglas screens separating customers on some dining tables in cafeterias have been proposed as a barrier to prevent the projection of large droplets (Fig. 3).

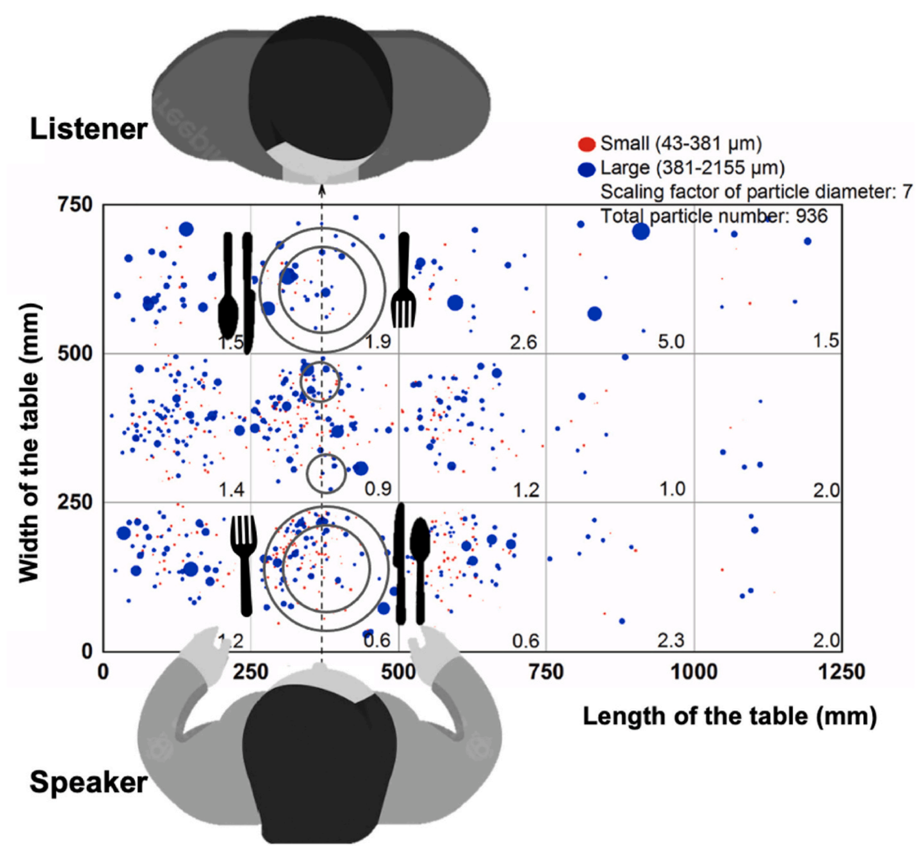

Fig. 2. Deposition characteristics of speech droplets deposited from the 3-min "speaking activity": large droplets in blue and small in red. Figure adapted from Ding, S. et al. article, with editor and authors authorization (Ding et al., 2022). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

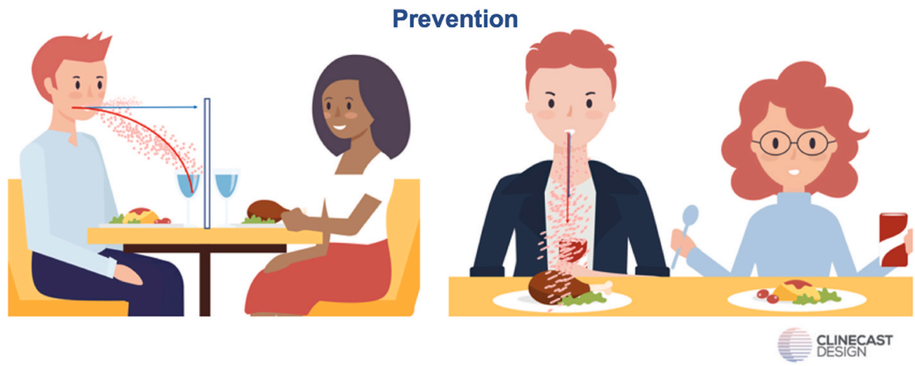

Fig. 3. PVC/plexiglas screens or side-by-side eating could reduce contamination risk.

3.5. *Can hand or food be involved as vectors?*

In nasal discharge, saliva, sputum and tears, the virus in liquid phase retains infectivity and stability for up to 21 days especially in cold areas or in the winter time (Kwon et al., 2021). Hands soiled by the nasal discharge of symptomatic participants may also have contaminated shared glasses, cold food (shared bread, for example) and cutlery.

Redmond et al. showed that hand samples were positive for RNA of SARS-CoV-2 (viral infectivity not addressed) among 75% of selected patients (nasopharyngeal testing, Ct value ≤ 30) (Redmond et al., 2021). Biopersistence of SARS-CoV-2 on human skin (see **supplementary table** for details) including the hands was shown to be ten times longer for Omicron SARS-CoV-2 (21 h) (Hirose et al., 2021, 2022) than for influenza virus (2 h) (Hirose et al., 2021). Infectious virus was still present on skin (*Sus scrofa*) for 96 h at 22 °C and for 8 h at 37 °C (Harbourt et al., 2020). Data that evaluate the amount and viability of SARS-CoV-2 on infected patients' hands were rare, even though such data is of great interest. A study on 75 hospitalized COVID-19 patients showed infectious SARS-CoV-2 (6×10^1 to 2.3×10^2 PFU/mL) in hand swab samples (Lin et al., 2022).

A real-life experiment with ten COVID-19 cases was conducted around Halloween in the USA. SARS-CoV-2 RNA was detected on 60% of the wrapped candies on which ten patients had deliberately coughed but also on 60% of the wrapped candies handled with unwashed hands (Salido et al., 2020). SARS-CoV-2 RNA is also very often identified on surfaces touched with hands (Luo et al., 2020). Despite the reduction in titer related to the transfer from soiled hands to a surface (around 80%), the amount of OC43 coronavirus (around 1.0×10^4 PFU) ending up on food touched is compatible with a potentially infectious virus (Dallner et al., 2021) while no infectious viral titer loss (around 1.5×10^2 PFU/mL) was observed after a direct hand-to-hand transfer (Lin et al., 2022).

A study performed in Toronto hospitals showed that the virus could be cultured in 17% of the touched surface samples (6/36) while no culturable virus could be obtained in the air samples (Kotwa et al., 2022). Contamination of chopsticks or cutlery by patients was suggested by positive testing of SARS-CoV-2 RNA on the dining table or in the kitchen (Lui et al., 2020; Luo et al., 2020). Similarly, the virus was found to be infectious *e.g.* on bed rail (1.5×10^3 PFU/mL), phone and call bell (2.0×10^2 to 1.9×10^3 PFU/mL), paper tissues (4.0×10^1 to 2.0×10^3 PFU/mL), bedsheets (1.2×10^2 PFU/mL) samples (Lin et al., 2022).

Experimental studies showed that SARS-CoV-2 inoculated onto different food products remains infectious for several days (**supplementary table**). At refrigerator temperature (4 °C), SARS-CoV-2 stays infectious for up to 8 days on salmon (Dai et al., 2021). Products such as fruits, deli meats and meats rich in protein, fat, and humidity maintained SARS-CoV-2 infectivity around 24 h and up to 21 days. Infectious SARS-CoV-2 remained at a consistently high titer for 24 h after inoculation on tomatoes, grapes, as well as rare or undercooked ground beef (Jia et al., 2022a) (see **supplementary table** for details). The virus also remained infectious between days 7 and 35 in numerous beverages: fruit juices, alcoholic beverages, milk and water (Jia et al., 2022b; Fukuta et al., 2021). Infectious SARS-CoV-2 deposited on food, cutlery/glass, or beverages may have the potential to enter and replicate within a host's cells after ingestion, as the oral cavity, the salivary glands and the gastrointestinal tract express the ACE2 and TMPRSS2 receptors (Drozdzik et al., 2022; Song J. et al., 2020; Xiao et al., 2020). Saliva, loaded with infectious virus (for example 1×10^1 to 4.6×10^4 PFU/mL) (Lin et al., 2022), is swallowed and travels through the digestive tract: SARS-CoV-2 was shown to be resistant to gastric acidity and intestinal bile, especially in the presence of food (Esseili, 2022) and infectious virus was ultimately found in stool samples (Zhou et al., 2020; Jeong et al., 2020). In fact, SARS-CoV-2 was isolated in bat/human intestinal organoids (Jeong et al., 2020) and productive infection was obtained in a ferret model from patient stool samples (Zhou et al., 2020).

COVID-19 patients may present gastrointestinal disorders as the only clinical manifestation of SARS-CoV-2 infection without any pulmonary involvement (Song Y. et al., 2020). The relevance of an intermediate vector/media, such as hands or food/surfaces, impacting viral transmission, has also been discussed for the influenza virus, another well-known virus with respiratory tropism also presenting digestive manifestations (Minodier et al., 2015).

To prevent possible spread of the virus through contaminated hands, hand washing seems essential: a case-control study confirmed that hand washing after an outdoor activity and before touching the mouth and nose area was associated respectively with a 98% and 70% reduction in the risk of infection ($p < 0.005$) (Lio et al., 2021). Another study of 296 cases and 536 controls among workers in Kazakhstan evaluated factors associated with SARS-CoV-2 transmission. Among the individual factors studied, multivariate analysis showed an excess risk associated with infrequent (aOR 4.1; 95% CI 1.8–10.1) or no use (aOR 3.0; 95% CI 1.2–7.6) of hand sanitizer, and with off-duty social interactions (aOR 1.8; 95% CI 1.2–2.9) (Nabirova et al., 2022).

4. Conclusion

The amount of infectious virus in large droplets emitted and deposited on intermediate vectors such as glasses, beverages, cutlery and food on plates has to be considered in an environment where masks can rarely be worn. The food route and vectors such as glasses or cutlery may contribute relevantly to the risk of infection in addition to the traditional direct respiratory route, particularly because it is impossible to observe primary barrier measures in places and at the time of social festivities. With this dual mode of transmission comes the difficulty to quantify the proportion each route contributes to overall spread. The other aspect is that infected persons preparing or serving food or beverages without masks could transmit at distance without the target being directly exposed to the source person. Hands soiled by symptomatic (especially runny nose) or asymptomatic index cases and contamination of consumed cold food must likewise be taken into consideration, even for other respiratory viruses. Use of masks and hand hygiene which contribute to prevent virus spread both remain useful measures for food handling staff. Evidence suggests that COVID-19 vaccination, although it significantly reduces the likelihood of severe outcomes especially for comorbid conditions, only has a slight impact on the transmission of new variants and does not prevent superspreading events. As public health measures worldwide are being relaxed, we contend that there is a sustained need for context specific adjustments and that some layers of protection must be respected, in particular in settings where food and drinks are shared.

Ethics statements

Not required.

Ethics approval

Not applicable.

Contribution

The authors are grateful for original infographics and drawings realized by Céline Lenoir from Clinecast Design. AS and JMW contributed equally to this work. All authors contributed extensively to proofing, and final sign-off of the article. All authors have no competing interest in this study. No fund was received for this study.

Declaration of competing interest

AS and JMW contributed equally to this work. All authors contributed extensively to proofing, and final sign-off of the article. The authors have no competing interest in this study.

Data availability

No data was used for the research described in the article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.fm.2023.104297.

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